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GB 1571289
GB 1509002
GB 1486056
GB 1338105
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(58) Field of search
D1J

(54) Cable guiding device for mine vehicle

(57) A device (Fig. 2) for evenly spooling a trailing electric cable (32) onto a cable reel drum (38) mounted on a mine vehicle powered via that cable includes a rotatable cylindrical cam (102, Fig. 4) rotatably driven in a predetermined ratio to the speed of rotation of the drum. The cable passes to the drum through a reciprocable cable guide mounted on a pivotally oscillatable assembly (152, 138, 134, 132) which includes a cam follower (132) which engages in a cam track formed in the surface of cam (102). Thus, as the cam 102 rotates, the cable guide swings through a shallow arc approximating to a straight line parallel to the axis of rotation of the drum whereby the guide is moved over the entire axial extent of the drum at a predetermined constant velocity parallel with the drum axis. The cam track on the rotatable cam is arranged to provide an immediate change in direction of movement of the cable guide when the cable guide arrives at either end of the cable reel drum.

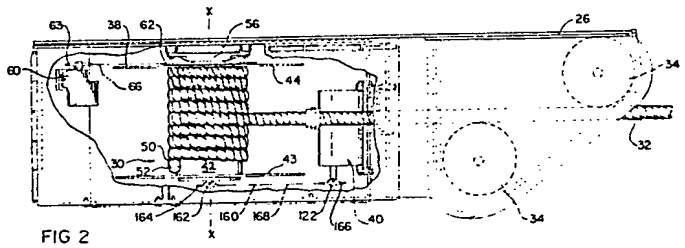

FIG 2

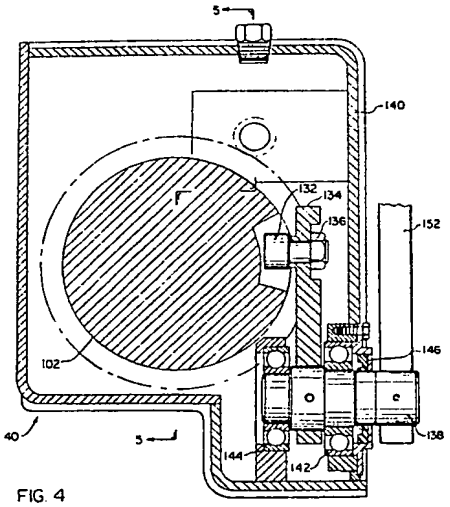

FIG. 4

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SPECIFICATION

Cable guiding device for mine vehicle

This invention relates to electrically driven mine shuttle cars and more particularly to the mechanisms carried thereby for reeling in and paying out cables through which electric power is delivered to the cars.

There are various electrically powered vehicles such as shuttle cars used in underground mining which do not carry a self-contained power source therewith, but which are provided with electrical energy by means of electrical trailing cables which extend between a power source and the vehicles. In such a vehicle, a cable reel assembly is generally used to carry the trailing cable to selectively pay out and reel in the cable as the movement of the vehicle necessitates. In the operation of such prior cable reel assemblies, however, there have been experienced problems such as jamming, sticking, (which causes the cable reel to stop suddenly breaking the cable) and rapid wear.

It is among the objects of this invention to provide a mine vehicle incorporating an improved cable reeling device and to provide an improved cable reeling device for such a vehicle.

According to one aspect of the invention, there is provided a mine vehicle of the type having an electric trailing cable wound onto a rotatable cable drum mounted thereon, and a device for evenly spooling said electric cable onto said drum, said device comprising;

a rotatable cylindrical element rotatably driven at a speed in a predetermined ratio to the speed of rotation of said drum, said cylindrical element having a cam surface thereon;

a cam follower cooperable with said cam surface, said cam follower being connected with a cable guiding means capable of moving through an arc substantially parallel to the axis of rotation of said drum, the arrangement being such that during rotation of said drum at a uniform rate, said guiding means will move with respect to the drum through the entire axial extend of said drum at a velocity, in the direction parallel with the axis of the drum, which is substantially constant, and

said cam surface on said rotatable element being positioned to provide an immediate change in the direction of movement of said cable guiding means when said cable guiding means arrives at either end of said cable reel drum.

According to another aspect of the invention, there is provided an apparatus including an electric cable, a rotatable cable reel drum for reeling in and paying out said cable and a device for guiding the cable onto said drum, said device comprising:

a rotatable cylindrical cam having a camming tract cut in the cylindrical surface thereof;

a cable guide means engagable with said cam track, said cable guide means being capable of moving substantially parallel with the rotary axis of said cable reel drum, said cam track being adapted [illegible] to move in a back extent of said drum for each revolution of said cylindrical cam; and

a means for rotating said cylindrical cam at a speed bearing a predetemined ratio to the speed of rotation of said cable reel drum whereby said cable guide means moves axially a distance substantially equal to the diameter of said cable for each revolution of said cable reel drum.

According to a yet further aspect of the invention there is provided an apparatus including an electric cable, a rotating cable reel drum for reeling in and paying out said cable and a device for guiding the cable onto said drum, said device comprising:

guide means for guiding said cable onto said cable reel drum, said guide means being mounted for pivotal movement about a pivot point whereby a cable engaging part of said guide means can move along an arc, about said pivot point, which arc extends generally parallel with the rotational axis of said cable reel drum; and

means for oscillating said guide means about said pivot point so that said cable engaging part moves along said arcuate path a distance, parallel with the axis of said drum which distance is substantially equal to the diameter of said cable, for each revolution of said cable reel drum.

According to a still further aspect of the invention, there is provided a device for guiding an electric cable onto a rotating cable reel drum, said device comprising guide means mounted for oscillatory movement in a support, whereby a cable engaging portion of said guide means can effect an approximately linear reciprocating movement, and means for imparting such oscillatory movement to said guide means.

An embodiment of the invention is described below by way of example with reference to the accompanying drawings, in which:-

Figure 1 is a view of a mine vehicle embodying the present invention.

Figure 2 is a view of the area of the mine vehicle shown in Figure 1 which includes a cable reel and guiding device,

Figure 3 is a side elevation view of the cable reel and guide means shown in Figure 2

Figure 4 is a sectional view showing part of a cable guiding device,

Figure 5 is a view of the cable guiding device shown in Figure 4 in section along line 5-5 in Figure 4, and

Figure 6 is a developed view illustrating the form of a cam surface on a roatable cam shown in Figures 4 and 5.

Referring to Figure 1, a mine haulage vehicle or shuttle car 10 is shown which incorporates therein a cable reel assembly comprising a body 12 mounted on pairs of front and rear traction and steering wheels 14 and 16, respectively, and additionally includes a material receiving compartment 18 extending longitudinally through the body 12 between wheels 14 and 16. Compartment 18 includes a material receiving end portion 20 and a material discharge end portion 22. Extending along the bottom of the compartment 18 is a conven-

charge end portion 22 includes a tiltable end frame 26 which is tiltable to effect variation in the discharge height of the conveyor. Arranged on one side of the discharge end portion 22 is an operator who controls station 28. Arranged on the opposite side of the discharge end portion 22 is a cable reel assembly 30 shown to a larger scale in Figures 2 to 5. A power conductor or cable 32 is wound on the cable reel assembly 30. The tiltable end frame 26 carries suitable guides 34 for the cable 32, whereby the later can be extended in various directions from the vehicle into connection with a suitable power source.

Inasmuch as the invention herein resides in the cable reel assembly 30 and in the guide means assembly 40 and as the balance of the elements specified hereinabove are well known in the art, further description of such known elements will not be set forth except whre necessary in the description of the invention herein. For purposes of the following description, the terms 'forward' and 'rearward' refer respectively to ends 20 and 22 of mine vehicle 10.

Cable reel assembly 30 comprises an elongated generally cylindrical cable reel 38 which is supported by a stationary bracket 56 for rotation about an axis X-X. Cable reel 38 includes an elongated generally cylindrical drum 42 and left and right flanges 43 and 44 which are secured to drum 42 at the respective axial ends thereof. A cable receiving opening 50 extends transversely through the drum assembly intermediate the axial ends thereof for receiving end portion 52 of cable 32 within the interior of the drum. The cable end 52 may be connected in any well-known manner to the electrical system of the mine shuttle car.

As indicated, the cable reel 38 is rotatably supported adjacent one axial end of bracket 56. The cable reel 38 is rotatably driven by means of a suitable hydraulic motor 60 which is fixably secured to the vehicle body and which receives hydraulic pressure fluid from any suitable source (not shown). A drive sprocket 62 is secured to cable reel 38 adjacent bracket 56 and extends radially outward therefrom. Motor 60 rotatably drives reel 38 by means of a chain 66 which extends between a drive sprocket 63 on the outward drive shaft the motor and the sprocket 62.

A cable guiding device generally denoted as 40 includes a rotatable cylindrical cam drum 102.

As can be best seen in Figure 5 the rotatable cam 102 includes a groove track 106 cut into the cylindrical surface thereof. The cylindrical cam 102 is supported within an oil filled enclosure 108 by a shaft 110 running axially through and fixed within, the cylindrical cam drum 102 and supported at either end by a pair of bearings 112 mounted on internal side walls 114 and 116 of the oil filled housing 108.

A gear 118 fixed to the shaft 110 engages a spur gear 120 which is mounted on the end of a drive shaft 122.

The drive shaft 122 extends through the side wall 114 of the housing 108 and is rotatably supther supported internally of the housing by a bearing 126 supported in a stationary bracket. A seal 128 surrounds shaft 122 and prevents any leakage of oil from inside the housing 108.

The housing 108 is filled with oil to lubricate the mechanism within housing 108. An opening fitted with a plug 130 allows the housing to be filled with oil and allows oil vapours to escape.

As be best seen in Figure 4, a preferred cam follower 132 engages the groove track 106 and is moved thereby as cylindrical cam 102 rotates. The cam follower 132 is a metal roller rotatably mounted on a cam follower arm 134 by a bolt 136. The cam follower arm 134 is fixedly mounted on a shaft 138 which extends through the side wall 140 of housing 108. The shaft 138 is supported inside wall 140 by a bearing 142 and is further supported within the housing by a bearing 144. A seal 146 encompasses shaft 138 to prevent loss of oil from housing 108.

As can be best seen in Figure 3, a cable guide 150 is mounted at one end of a cable guide arm 152, the other end of which is fixed on shaft 138 outside housing 108 the cam follower is moved by the cam 102 the arm 134, shaft 130 and arm 152 pivot as one about the axis of shaft 138 in bearings 142, 144. Consequently the cable guide 150 moves through a shallow arc which approximates to a straight line parallel with the axis of cable reel drum 42. During one full rotation of the cam drum 107 the cable guide 150 so moves, over the entire axial extent of the drum 42, from one end thereof to the other, and back again, thereby guiding cable 32 in a manner, as will be described in more detail below, to evenly space the cable 32 across the drum with each wrap a uniform distance from the adjacent wrap with no overlapping.

The cable guiding device 40 is driven by a chain drive generally denoted as 160 driven from a sprocket 164 fixed to a shaft 162 of cable reel drum 42. The shaft 162 is fixed with respect to drum 42 so that sprocket 164 rotates along with shaft 162 as cable reel drum 42 rotates. A second sprocket 166 is mounted on shaft 122 and is driven from the cable drum reel via sprocket 164 by a suitable chain 168.

As can be seen in Figures 4 and 5, the cable guiding device 40 is driven by the rotation of the cable reel drum 42. As the cable reel drum 42 rotates the shaft 122 rotates in a ratio depending upon the ratios of the diameters of sprockets 164 and 166. As shaft 122 is rotated, spur gear 120 drives gear 118 which rotates cylindrical cam 102. In the preferred embodiment the ratio between gear 120 and gear 118 is seven to one. Therefore one rotation of gear 118 requires seven rotations of spur gear 120. As the cylindrical cam 102 rotates, cam follower 132 is forced to move along the track 106 thereby causing rotational movement of shaft 138 and concommitant oscillation of the guide arm 152 and reciprocation cable guide 150 and guiding of cable 32 along the axial extent of drum 42.

The location of the cam track groove 106 on the

of the cable reel drum 42 in conjunction with the length of guide arm 152. The slope of groove 106 is predetermined so that upon each revolution of the cam 102 the guide and engaging means 150 makes one complete back and forth motion across the axial extent of drum 42. The linear velocity at which cable guide 150 moves measured parallel with the axial extent of the cable drum must be constant so that each wrap of cable is laid the correct distance away from the adjacent wrap of cable as the cable reel drum rotates. Consequently the ratios between the diameters of sprockets 164 and 166 must be precalculated based on the thickness of the cable 32 and the length of the cable reel drum 42. It should be noted that the groove in the cam is designed to give constant linear *horizontal* movement (i.e. movement parallel with the axis of drum 42) and to give quick changes in the direction of movement of the guide 150. The sprocket ratio only affects the speed of such movement. It can be seen that if it is desired to accommodate a different cable reel (a cable reel with a different axial length between flanges 43 and 44) it is only necessary to increase the length of the guide arm 152. This obviously increases the horizontal length of the arcuate path which the cable guide follows as rotation about the pivot point occurs.

Figure 6 shows the cam track groove 106 in "flattened out" or developed form and indicates the amount of rotation about the pivot point in a plus or minus direction for every five degree point throughout the 360 degree rotation of the cylindrical cam element 102. Since the guide eye 150 moves in an arc at the end of guide arm 152, there must be corrections made to keep the horizontal movement constant. In other words, the groove must slightly speed up or slow down the guide arm as it moves through its arc to maintain a constant horizontal velocity. The groove 106 in the cam cylinder 102 is designed so that every 5° of rotation of the drum will move the guide eye 150 the same horizontal distance regardless of its position in the arc (except at the change of direction).

If it is desired to change the sprocket ratio as would be required when the diameter of the cable is changed, the following method could be used to calculate the ratio between the sprockets 164 and 166. In order to calculate the ratios between the sprockets 164 and 166, one must take cable width or diameter including a 1/16 of an inch space between each cable wrap on the reel and divide this by the total horizontal travel desired by the cable guide. This length of travel is equal to the cable reel drum width in the axial direction minus the thickness of the cable since the guide only has to go to the centre line of the cable at each end of the cable reel drum. This ratio is then multiplied by half of the gear ratio between the spur gear 120 and gear 118. The reason the gear ratio is divided in half is that the cylindrical cam rotates only through 180 degrees as the cable guide makes one complete movement along the axial length of the cable reel drum.

For example, if cable having a diameter or has an axial width of 18 inches, then the desired cable guide travel is 16-5/16 inches. Assuming a .06 (1/16 of an inch) space between adjacent turns of the cable, the ratio required between sprockets 164 and 166 is equal to 1-3/4" (1-11/16" + 1/16") divided by 16-5/16" times 3-1/2 (half of the 7 to 1 preferred gear ratio) or a 3 to 8 ratio.

In normal operation of an electrically powered vehicle the cable reel spool or unspools at a slower rate or a faster rate depending upon the speed of the vehicle. It can be seen that the cable guide of the present invention will evenly space the cable regardless of the speed or direction of travel of the mine vehicle since it is powered by the rotation of the cable reel drum.

The cable reeling device described with reference to the drawings ensures accurate winding of the cable on the reel as the reel rotates and ensures that the cable will be evenly spaced across the reel, i.e. that each cable wrap is spaced in a uniform distance from the adjacent wrap with no overlapping.

Furthermore, the cable will be spooled on and off the cable reel evenly regardless of vehicle speed or direction of travel.

In addition, the drive ratio between the cable reel and the cable guiding device can be easily changed to accommodate different types and sizes of electrical cable.

CLAIMS

1. A mine vehicle of the type having an electric trailing cable wound onto a rotatable cable drum mounted thereon, and a device for evenly spooling said electric cable onto said drum, said device comprising;

a rotatable cylindrical element rotatably driven at a speed in a predetermined ratio to the speed of rotation of said drum, said cylindrical element having a cam surface thereon;

a cam follower cooperable with said cam surface, said cam follower being connected with a cable guiding means capable of moving through an arc substantially parallel to the axis of rotation of said drum, the arrangement being such that during rotation of said drum at a uniform rate, said guiding means will move with respect to the drum through the entire axial extent of said drum at a velocity, in the direction parallel with the axis of the drum, which is substantially constant, and

said cam surface on said rotatable element being positioned to provide an immediate change in the direction of movement of said cable guiding means when said cable guiding means arrives at either end of said cable reel drum.

2. A mine vehicle as set forth in claim 1 wherein said rotatable element is rotatably driven by a drive means connected to said rotatable cable reel drum.

3. A mine vehicle as set forth in claim 1 wherein the arrangement is such that said velocity of said guiding means parallel with the axis of the drum is equal to the thickness of the cable to be

make one revolution.

4. A mine vehicle as set forth in claim 1 wherein said rotatable element is a cylindrical spool having a cam track cut into its outer surface.

5. A mine vehicle as set forth in claim 1 wherein said rotatable cylindrical element is rotatably supported within an oil filled sealed housing and wherein said cam follower is disposed inside said housing and said cable guiding means includes a cable engaging and guiding portion which is external to said housing.

6. A mine vehicle as set forth in claim 5 wherein said cable engaging and guiding portion and said cam follower move through parallel arcuate paths.

7. Apparatus including an electric cable, a rotatable cable reel drum for reeling in and paying out said cable and a device for guiding the cable onto said drum, said device comprising:

a rotatable cylindrical cam having a camming tract cut in the cylindrical surface thereof;

a cable guide means engagable with said cam track, said cable guide means being capable of moving substantially parallel with the rotary axis of said cable reel drum, said cam track being adapted to cause said cable guide means to move in a back and forth reciprocal motion along the entire axial extent of said drum for each revolution of said cylindrical cam; and

a means for rotating said cylindrical cam at a speed bearing a predetermined ratio to the speed of rotation of said cable reel drum whereby said cable guide means moves axially a distance substantially equal to the diameter of said cable for each revolution of said cable reel drum.

8. Apparatus as set forth in claim 7 wherein said cable guide means has a cable engaging and guiding portion at one end thereof and a cam follower engaging said camming tract at another end thereof.

9. Apparatus as set forth in claim 8 wherein said cable guide means moves in an arcuate path.

10. Apparatus as set forth in claim 7 wherein said cylindrical cam is rotatably supported within an oil filled sealed housing and wherein said cable guide means includes a cam follower portion inside said housing and a cable engaging and guiding portion which is external to said housing.

11. Apparatus as set forth in claim 10 wherein said cable guide means and said cam follower portion move through parallel arcuate paths.

12. Apparatus as set forth in claim 7 wherein said means for rotating said cam is driven by the rotation of said cable reel drum.

13. Apparatus including an electric cable, a rotating cable reel drum for reeling in and paying out said cable and a device for guiding the cable onto said drum, said device comprising:

guide means for guiding said cable onto said cable reel drum, said guide means being mounted for pivotal movement about a pivot point whereby a cable engaging part of said guide means can move along an arc, about said pivot point, which arc extends generally parallel with the rotational

means for oscillating said guide means about said pivot point so that said cable engaging part moves along said arcuate path a distance, parallel with the axis of said drum, which distance is substantially equal to the diameter of said cable, for each revolution of said cable reel drum.

14. Apparatus as set forth in claim 12 wherein said guide means includes an arm having said cable engaging part at a first end thereof, said arm being pivoted at said pivot point at a second end of the arm whereby said cable engaging part is disposed a predetermined distance from said pivot point.

15. Apparatus as set forth in claim 12 wherein said means for oscillating said guide means about said pivot point includes a rotatable cylindrical cam having a camming track in the cylindrical surface thereof; and

a cam follower cooperable with said cam surface, said cam follower oscillating about said pivot point as said cylindrical cam rotates.

16. Apparatus as set forth in claim 15 wherein said means for guiding said cable and said cam follower move through parallel arcuate paths about said pivot point.

17. A device for guiding an electric cable onto a rotating cable reel drum, said device comprising guide means mounted for oscillatory movement in a support, whereby a cable engaging portion of said guide means can effect an approximately linear reciprocating movement, and means for imparting such oscillatory movement to said guide means.

18. A device according to claim 17 wherein said means for imparting such oscillatory movement to said guide means includes a rotary input member and means for converting rotary movement of said input member into oscillatory movement of said guide means, such that said cable engaging portion moves a predetermined distance, measured along a straight line to which the movement of the guide means approximates, for each equal predetermined increment of rotation of said input member, when the cable engaging portion is intermediate the limits of its movement.

19. An electrically powered mine vehicle incorporating a device according to claim 17 or claim 18.

20. A mine vehicle substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

21. A cable guiding device, substantially as hereinbefore described with reference to, and, as shown in, the accompanying drawings.

22. Any novel feature or combination of features described herein.

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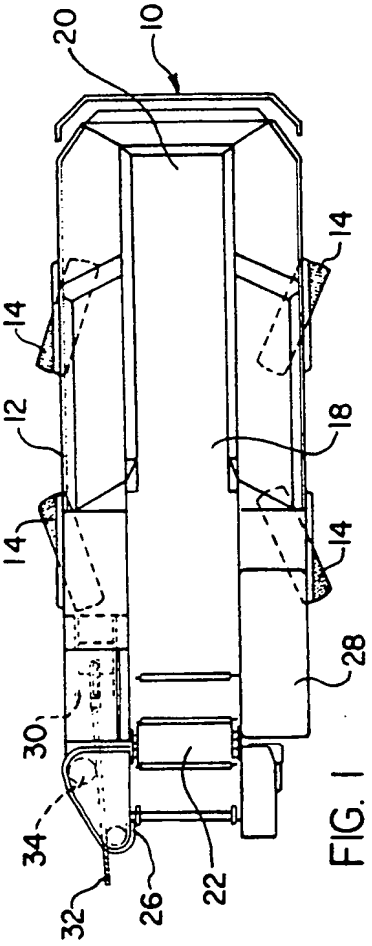
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FIG. 1

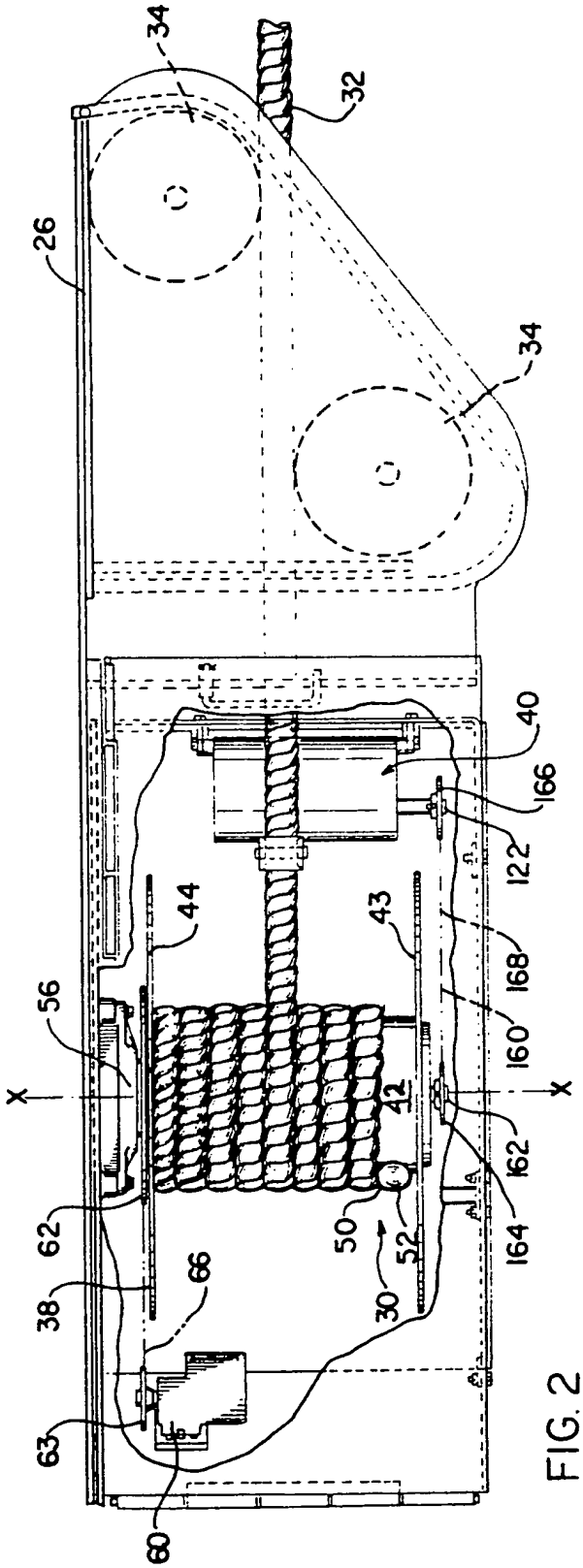
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FIG. 2

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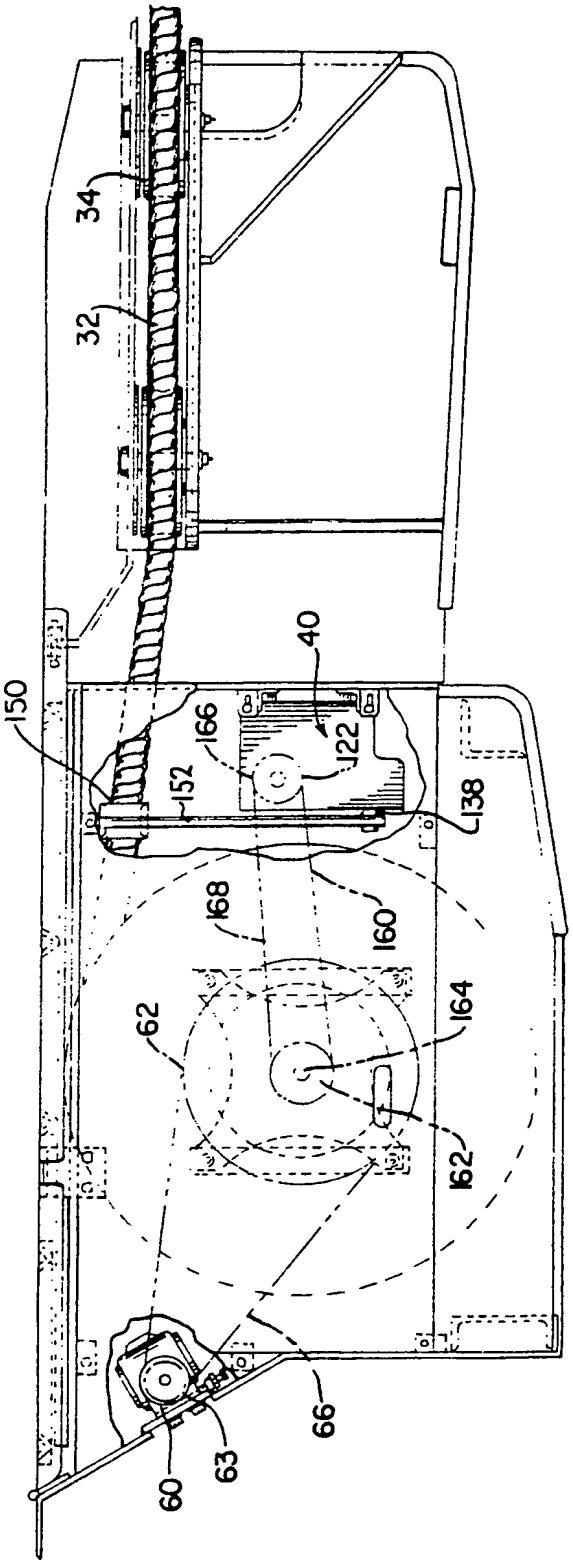


FIG. 3

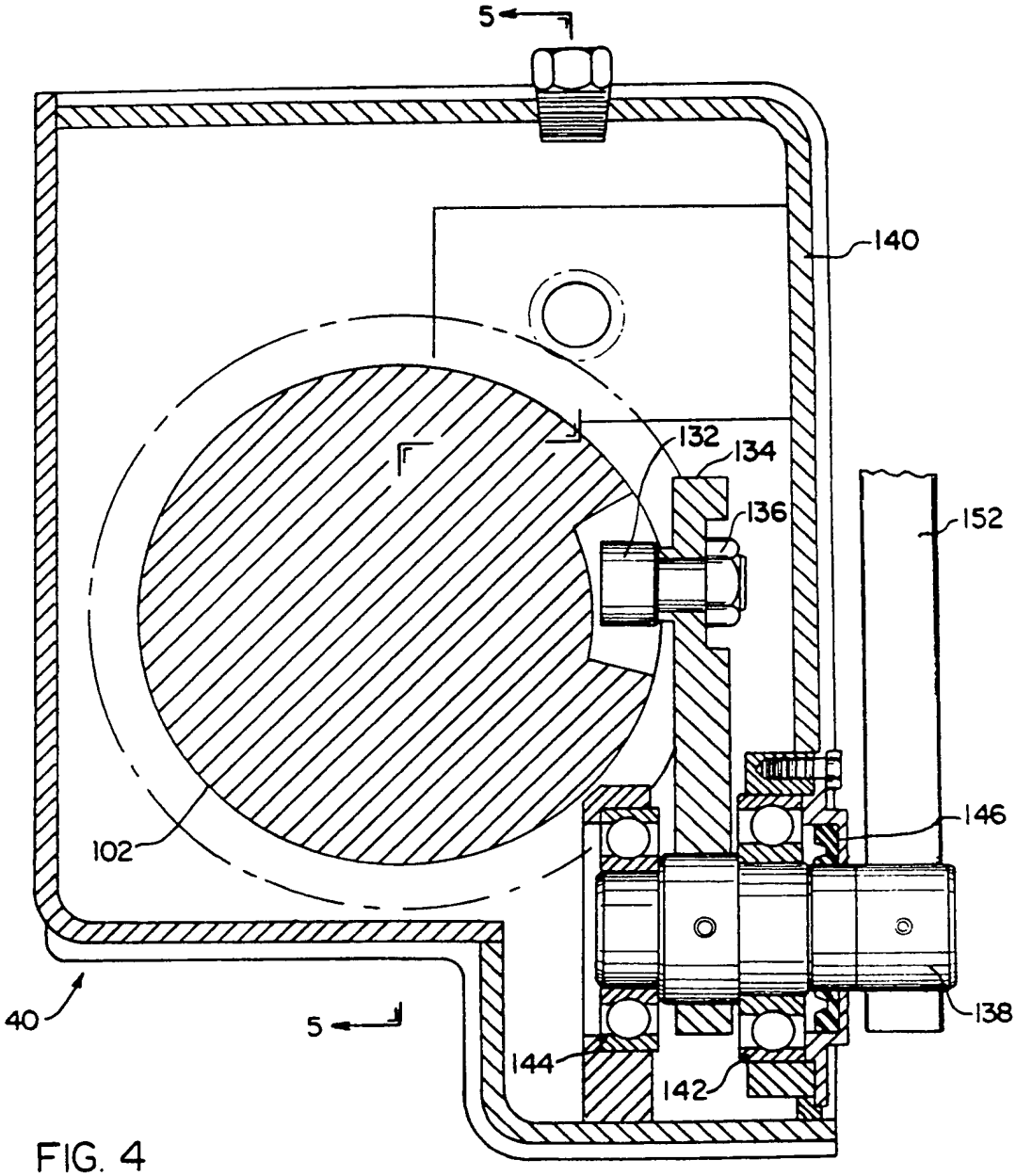


FIG. 4

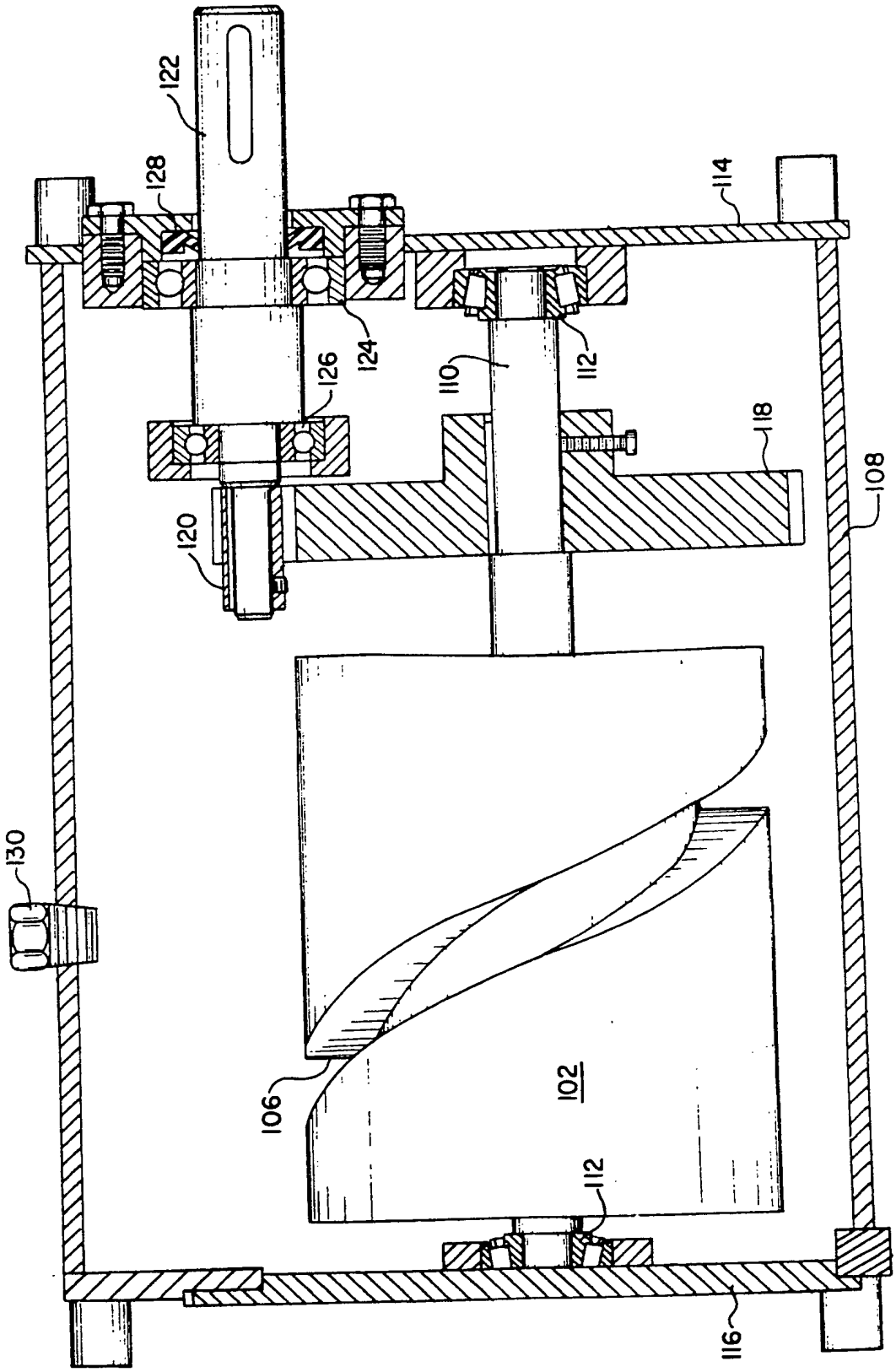
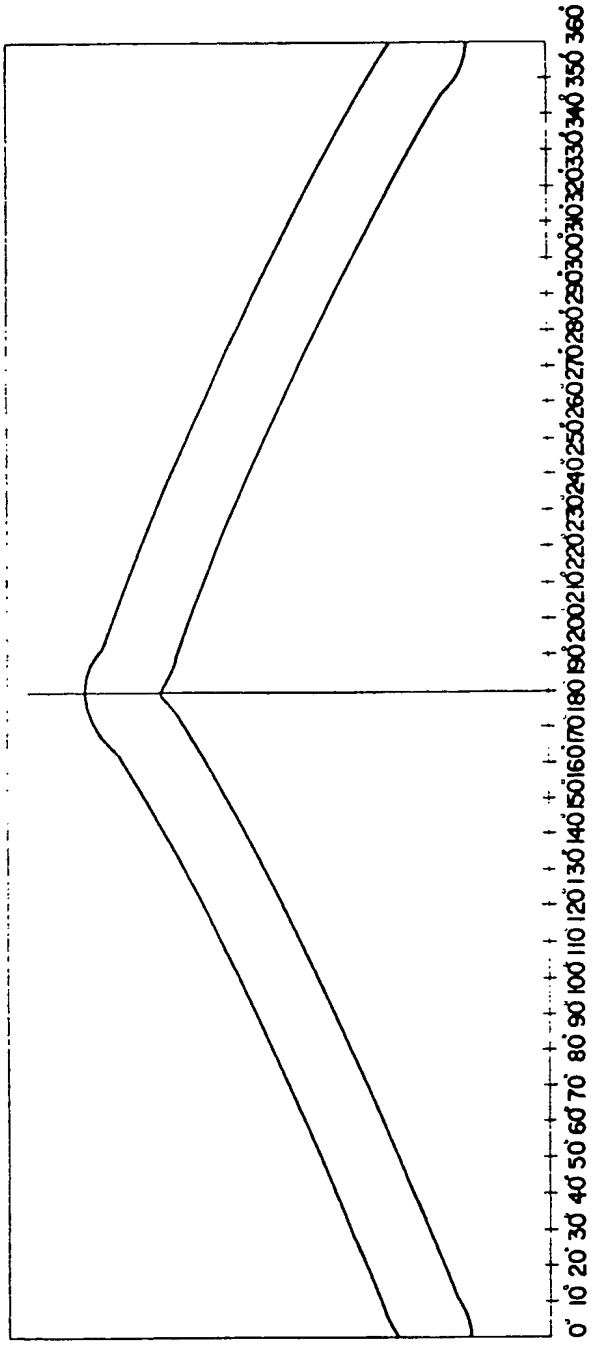


FIG. 5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DEGREE'S OF ROTATION

FIG. 6